LETTERS TO THE EDITOR

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Properties of Selenium

In a letter headed "Anomalous behaviour of Selenium," which appeared in NATURE (vol. xii., p. 187), Mr. Gordon states that "it has lately been observed that the electrical resistance of selenium is greater in light than in the dark." I am anxious to learn where an account of this remarkable observation is to be found.

Mr. Gordon afterwards announces the discovery that a bar of granular selenium belonging to the Cavendish Laboratory exhibits a decrease of resistance under the influence of light. This phenomenon was well-known outside the Cavendish Laboratory more than two years ago. Mr. Gordon also states that the very high resistance of a certain medal of selenium did not sensibly alter under the influence of light; and concludes that "the physical form of the metal" seems to have some influence on its electrical properties. From his description of the medal it would appear that it is made of vitreous selenium. I am therefore surprised that its resistance was so low. A conducting form of selenium having the appearance of black-lead is certainly a novelty.

It is perhaps not generally known that the electrical properties of selenium are very variable. In a paper by Mr. Henry Draper and myself which appeared in the "Proceedings of the Royal Irish Academy" (vol. i. ser. ii. (Sci.) p. 529), we have shown that there is a granular variety of the element which is, at ordinary temperatures, apparently as good a non-conductor as the vitreous variety. Unlike the latter, however, it cannot be rendered electrical by friction. Another granular modification of the element was found to conduct electricity comparatively well in darkness, and scarcely any better under the influence of light; while there is an intermediate state of the element which appears to possess a molecular structure so susceptible of change, that light is capable of converting it temporarily into the form which conducts comparatively well. Some bars which we prepared of this sensitive variety exhibited an increased conductivity of 100 per cent. under the influence of sun-light. In appearance there is not the slightest difference between this and the non-conducting granular variety, both exhibiting a gray granular fracture resembling that of the metal cobalt. In the course of our experiments Mr. Draper and I prepared a large number of bars and plates of various shapes and sizes, but we have not observed any unusual connection between the shape of the bars or plates and their resistance. There is a great difficulty in making observations with reference to this point, as we are as yet unable to produce two or more bars of the sensitive variety possessing the same electrical properties. Thin plates are generally more sensitive to light than cylindrical bars, but we have occasionally prepared bars as sensitive in proportion as a plate measuring 75 × 15 mm., and only 0·5 mm. in thickness.

I have not as yet been able to learn the contents of Prof. Adams's recent paper on this subject, but Mr. Gordon says that he has shown that the phenomenon is a purely optical one. I may state that Mr. Draper and I have long since shown that, so far as the effect of heat on electrical resistance is concerned, some forms of granular selenium conform to the metallic type. This was demonstrated by placing a plate of selenium inside a spiral of platinum, at a distance of about 4 mm. from the wire. The usual decrease of resistance took place when the plate was exposed to light; but on heating the surrounding platinum wire by passing a current of electricity through it, the resistance of the selenium increased considerably. The effect of light is therefore partially counterbalanced by the effect of the heat which usually accompanies it. This partly explains the increase of resistance that is known to follow prolonged exposure to light. A portion of this increase being doubtless due to the slight elevation of temperature that must result from the passage of the current through the selenium. The opposite action of light and heat is very remarkable, especially as the longest light undulations are those that cause the greatest decrease of resistance. It is remarkable, also, that a thin film of non-conducting vitreous selenium transmits these red rays, while an equally thin film of granular selenium is perfectly opaque to them.

RICHARD J. MOSS

Mr. Darwin and Prof. Dana on the Influence of Volcanic Action in preventing the growth of Corals

In his critique on the new edition of Mr. Darwin's work on Coral Reefs (NATURE, vol. x., pp. 408-410), Prof. Dana adduces four examples of islands in which he thinks comparatively recent volcanic action has prevented the formation of extensive coral reefs. One of these is Savaii, the largest island of Samoa.

Some time ago I read Prof. Dana's "Corals and Coral Islands," while on a tour on Savaii, and on the margin of page 302 I noted this very point now brought forward by the author in his paper in NATURE, intending, at some future time, to show that his view respecting this island is based upon imperfect knowledge, and is altogether incorrect.

I do not intend to enter here into all the details respecting Prof. Dana's incorrect statements, but will confine myself to the one point on which his views and those of Mr. Darwin are at variance. In his work (p. 302) Prof. Dana says: "Savaii abounds in extinct craters and lava streams, and much resembles Hawaii in character; it bears proof in every part of being the last seat of the volcanic fires of the Samoan Group. *Its reefs are consequently few and small.*" In NATURE (vol. x. p. 409), he says: "Savaii has coral reefs on its *western* (eastern) and northern shores, while elsewhere without them. *I failed to find evidence in the case of either of these volcanic regions that they are situated within areas of elevation* rather than subsidence. *Only ten miles* west (this should be *east*) of Savaii lies the large island of Upolu, having very extensive reefs—on some parts of the north side three-fourths of a mile wide; and it has not seemed safe to conclude that while Upolu thus bears evidence of no movement or of but little subsidence, Savaii was one of elevation; or *that the north and west* (*east*) *sides of Savaii have differed in change of level from the rest of the island.*"

In the above passage Prof. Dana has reversed the relative positions of Savaii and Upolu. Savaii is *west* of Upolu, and its reefs are on the *eastern end next to Upolu*, and extend for some distance on its north-eastern side. Its south, west, and north-west sides are free from coral reefs *except in bays*, where they are very narrow.

Now what Prof. Dana did not consider it "safe to conclude," viz., that part of Savaii had "differed in change of level from the rest of the island," is nevertheless a *fact*. And more than that, those parts of the island which present unmistakable evidence of upheaval *are destitute of a coral reef on their shores*, except the narrow fringes above mentioned.

The elevated portions of the island commence at the south-eastern point, in a line with three small islands which stand in the straits between Upolu and Savaii, and which doubtless indicate the line of fissure. I have traced the upheaval for many miles along the southern coast. In some places there are *old water-worn cliffs* from twenty to thirty feet above the cliffs which at present form the coast line, and which are themselves from twenty to thirty feet above high-water mark. These old cliffs are usually within two or three hundred yards of the present coast line, but are sometimes more distant. I have not at present traced this upheaval around the entire western end of Savaii, but I have observed the point at which it commences on the northern side, as well as at the south-eastern extremity.

How this fact tells on the point on which Prof. Dana's view differs from Mr. Darwin's, I may leave to those who are familiar with the subject to decide. My own conviction is, that instead of furnishing proof of the correctness of Prof. Dana's view, Savaii supplies a remarkable example of the correctness of that of Mr. Darwin, that, *ceteris paribus*, the extent of coral reefs is chiefly determined by the depth of water on the coast.

I have visited and examined a good many intertropical islands of the Pacific belonging to the three orders: 1. Volcanic islands with fringing coral reefs, such as Samoa, the New Hebrides, &c. 2. Atolls, such as the Low Archipelago, Ellice, Gilbert Islands, &c. 3. Upraised coral islands, such as Niuē or Savage Island, part of the Friendly, the Loyalty Islands, &c. I have studied their structure with Mr. Darwin's "Coral Reefs" as my text-book; and the further I have gone the more firmly have I been convinced of the correctness of his theory.

Prof. Dana is, without doubt, correct in his opinion that submarine or littoral volcanic action would destroy living corals which came within its influence; and it might for a time, even after the volcano became quiescent, prevent the spread of corals within the area affected by it. But the fact that in some of the areas where extensive reefs are not found, narrow coral fringes exist in bays (as at Savaii), where the slope of the shore is less

steep, is positive proof that the non-existence of extensive reefs cannot in such places be owing to any deleterious influences arising from volcanic action, but must be on account of the depth of water on the coast. S. J. WHITMEE

Upolu, Samoa

Mirage on Snowdon

ON Monday, July 12, I, with a party, ascended Snowdon. The atmosphere was clear until we had reached within half a mile of the summit, when a light cloud rising stealthily from amongst the southern peaks enveloped it. Drifting towards us, when very near, the cloud dropped over the eastern shoulder of the mountain just where it dips towards Capel Curig. As we stood watching, great was our surprise and delight as we beheld painted upon it, not the *arc-en-ciel* with which we are familiar, but a complete and brilliant prismatic circle, apparently about thirty feet in diameter, in the very centre of which we ourselves were depicted, the image being somewhat enlarged but clearly defined; as we arranged the party in groups, or bowed to each other, every form and movement was faithfully reproduced in the picture. It was now about 8 o'clock, with the sun nearly in a line with us. Our guide, who had made some hundreds of ascents, had never witnessed such a sight before. H. J. WETENHALL

Fordfield, Cambridge

OUR ASTRONOMICAL COLUMN

KEPLER'S NOVA, 1604.—We learn from Prof. Winnecke that, in consequence of the remarks upon this star which appeared in NATURE, vol. xi. p. 249, he has lately examined the neighbourhood, and, in addition to the star of 11·12th magnitude there mentioned—the position of which for 1855·0 he finds to be R.A. 17h. 22m. 4·6s., N.P.D. 111° 23·6′—he found one of 12th magnitude in R.A. 17h. 21m. 49·3s., N.P.D. 111° 19·3′. This star agrees almost precisely in place with the 10th magnitude marked upon No. 52 of Chacornac's charts, though not at present of that brightness; but we are able to state that in August 1871 and June 1872 nothing was visible in this position in a telescope which would show stars to 13·14 magnitude in Winnecke's scale. It will be desirable to watch this small star closely, as it is quite possible it might be identical with Kepler's famous star, the observed place of which is not so accurately known as in the case of the similar object observed by Tycho Brahe in 1572. Prof. Winnecke, however, suggests that, as the star marked by Chacornac is just upon the margin of his map, where some distortion exists, it might possibly be identical with No. 16,872 of Oeltzen's Argelander, a star estimated 8·9 in the Bonn Zones; still the place of the 12th magnitude agrees much more closely with that of Chacornac's 10th, read off from his chart as nearly as the circumstances permit. It may be well to compare the fainter star found by Prof. Winnecke, from time to time with the 11·12th close at hand, and easily identified if the instrument be set for Argelander's star, which may be considered a bright 9th magnitude.

THE BINARY STAR 4 AQUARII.—If good measures of this star are practicable during the present season, an idea of the form of the orbit may perhaps be obtained. Dawes's series of epochs will be of material service in this respect; without them, doubt might have been occasioned by the two discordant epochs of Mädler, which may have been owing to distorted images at low altitude. The object is certainly one of considerable difficulty, and really trustworthy measures are perhaps only to be expected from practised observers in command of instruments of excellent definition. In Barclay's second catalogue it is described as just elongated in the direction 144°, with power 450 on the 10-inch refractor at Leyton, at the epoch 1865·74; this angle shows direct progress, very much in accordance with Dawes's measures. Possibly the companion may now be found nearly due south of the primary.

THE NEBULÆ.—Prof. Schönfeld has published in Part II. of "Astronomische Beobachtungen zu Mannheim"—Carlsruhe, 1875—a continuation of the valuable series of observations commenced by him in 1860, for accurate determination of the positions of a selected list of nebulæ. In this second part we have the places of 336 of these objects, obtained by direct reference to stars, which, as in the case of those employed in fixing the positions of the nebulæ included in the first part (Mannheim, 1862), have been meridionally determined at Bonn by the late Prof. Argelander; the mean places are found in Vol. vi. of the Bonn Observations. Schönfeld's epoch is as before, 1865·0, for which year the precessions are computed with Bessel's constants, still preferred by many of the German astronomers. The differences from Schultz's Preliminary Catalogue are shown, and are generally small. As one result of more recent observations, it is remarked by Schönfeld that a sensible proper motion of the great nebula in Andromedæ, which appeared to be indicated by a comparison of Flamsteed's observations with those of D'Agelet and Lalande, is not confirmed.

Prof. Adams, in his last address as President of the Royal Astronomical Society, remarks upon the great value attaching to Schönfeld's micrometrical observations of the nebulæ, of which we have here the continuation.

ENCKE'S COMET.—Mr. J. Tebbutt of Windsor, New South Wales, reports his discovery of a comet, which he supposed to be Encke's, on the morning of May 7th, in the constellation Cetus. It is, we believe, the second occasion upon which this able amateur astronomer has detected this comet, before the arrival of an ephemeris from Europe, and no doubt in the present case his independent discovery, which he communicated telegraphically to the Government astronomers at Sydney and Melbourne, will lead to a number of observations for position at the Australian observatories, which might have been otherwise lost. The search for comets without the aid of an ephemeris is hardly an occupation which can be expected in a public observatory, where time is valuable for routine work—hence an argument for the early and general publication of ephemerides—and an inducement for some amateurs, especially in southern latitudes where a great necessity for systematic sweeping of the sky in search of comets appears still to exist, to so employ their leisure time. One at least of the lost comets of short period, is far more likely to be recovered in the southern hemisphere, than in these latitudes.

THE ARGENTINE OBSERVATORY.—Dr. Gould has just circulated in two small pamphlets, in English, the annual Report for 1874 of proceedings at the Observatory of Cordoba, and at the Meteorological Office, which has also been organised by this distinguished astronomer. With regard to astronomical work, the observations for the "Uranometry" are completed, as already mentioned in this column. The charts will be thirteen in number, including the whole of the southern heavens as well as the first ten degrees north of the equator, and about 8,500 stars will be represented upon them, of which about nine-tenths have southern declination. A catalogue will accompany the Atlas, as with the works of Argelander, Heis, and Behrmann. The zone-work was in a very forward state, 82,537 stars having been observed, and with the exception of an insignificant number of zones for which it might be necessary to wait till a later period of the year, Dr. Gould expected to complete this laborious undertaking by the end of last month. The third of the principal sub-divisions of work at Cordoba, the formation of what is called "the smaller Catalogue" is also well advanced: the catalogue is intended to consist of nearly 5,000 of the brighter stars of the southern heavens, each one observed not less than four times; in the year 1874, 12,500 observations of 3,600 different stars were made, the greater number during Dr. Gould's visit to his native city, a sufficient proof that he has been